

MODEL 1020-MS
MICROPROCESSOR SCAN SYSTEM
INSTRUCTIONS MANUAL

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I. Introduction:

The Microprocessor Scan System accessory for the H-10/H-20/HR-320 line of monochromators consists of two modules: a control module and a stepping motor unit. Installation of the stepping motor onto the monochromator is described in the appropriate monochromator instruction manual. This manual describes the operation of the control module.

II. Function Descriptions for Front Panel Controls: (see diagram I)

A. Displays -

1. LED "Wavelength" Display - This digital display performs two functions. During scanning it indicates the current wavelength. When any of the keys λ , λ_1 , λ_2 , SPD or CYL are pressed, the value in the appropriate register will be displayed and new data may be entered. (No. 1 on diagram)
2. LED "Cycles" Display - This digital display indicates the number of cycles remaining to be scanned during cyclic or repetitive scanning. (No. 2 on diagram)
3. LED Functions Lights - These four LED's indicate the status of the scan in progress. "FWD" and "REV" indicate in which direction scan is proceeding, forward or reverse, respectively. "RUN" and "STOP" indicate whether the microprocessor is in scan or stop modes, respectively. Note: The "STOP" light will be lit whenever the controller is in the "Backlash Correction" mode, even though the motor may still be running. (No. 3 on diagram)

- B. Black Numerical Keys - These keys, numbered 0 to 9, are used for entering into the microprocessor memory, the various user programmable scan functions. (No. 4 on diagram)

C. Register Keys:

1. "CLR" Key - This key clears the individual register which is punched directly preceding the use of the CLR button. e.g., Pressing λ_1 , then CLR will clear the λ_1 register. This key should be used whenever you wish to enter the data into any register. (No. 5 on diagram)
2. λ Key - This key enables the user to initialize the controller to read the same wavelength as the monochromator. Data should be entered in the format 00000.0, with the numbers moving across the display to the left as each additional digit is punched in. e.g., Monochromator dial reads 253.7. Press λ , then CLR to clear the register, and then the keys 2, 5, 3 and 7. Note: If the digit after the decimal point is to be a 0 (zero), the zero must be explicitly keyed in to hold the decimal point in the correct position. Leading zeros need not be keyed in explicitly. (No. 6 on diagram)

3. λ_1 Key - This key allows data to be entered in the λ_1 register, which functions as the lower wavelength limit in the scan range. Digits should be entered in the same format as for the λ key. (No. 7 on diagram)
4. λ_2 Key - This key allows data to be entered in the λ_2 register, which is the upper wavelength limit in the scan range. Digits should be entered in the same format as the λ key. (No. 8 on diagram)
5. SPD - This key allows the user to enter the desired scan speed into its register. The maximum speed allowable is 1800 nm/min for the H-10/H-20 line, and 1800 Å/min for the HR-320. Keying in numbers larger than these will result in a default to these maximum speeds. Data should be entered in the following format: XXX with no decimal point. (No. 9 on diagram)
6. CYL - The CYL key allows the user to enter the desired number of scans for repetitive or cyclic scanning into the corresponding register. Maximum allowable number of cycles is 99. (No. 10 on diagram)

D. Control Keys/Switches:

1. STP - This key will cause the system to stop, after first performing a backlash correction. This will cause the system to appear to run after the STP key has been pressed. The system will return to the exact wavelength that it was at when the STP key was pressed. NOTE: This key will not function when the controller is already in the backlash correction mode. (No. 11 on diagram)
2. FWD - The "Forward" key causes the system to scan in the direction of increasing wavelength at the preselected speed. When λ is less than λ_2 , the system will stop at λ_2 . Thus, this key can also be used as a "go to λ_2 " key under these circumstances. (No. 12 on diagram)
3. REV - The "Reverse" key causes the system to scan in the direction of decreasing wavelength, at the speed selected by the "Scan/Slew" switch. When λ is greater than λ_1 , the system will stop at λ_1 . Thus, this key can also be used as a "go to λ_1 " key under these circumstances. (No. 13 on diagram)
4. CNT - The "Continue" key allows a scan that was interrupted by use of the "STP" function to be continued from where it left off. This is particularly useful during a cyclic or repetitive scan. (No. 14 on diagram)

5. STA - The "Start" key begins cyclic or repetitive scanning. Scanning will take place in the forward direction at the preselected speed until λ_2 is reached, and then return to λ_1 at either the scan or slew speed, depending upon the position of the Scan/Slew switch. Each time that λ_1 is reached in the reverse direction, the number of cycles remaining to be scanned will be decremented by 1, until no scans remain to be done. Important Note: If the number of cycles in the "CYL" register is 0, then pressing the "STA" key will only cause a backlash correction, with no scan taking place. Important Note: For all registers except SPD, the default value is zero. For the SPD register, the default value is the maximum scanning speed. While the system is in the STOP mode, pressing the λ , λ_1 , λ_2 , SPD or CYL keys, will cause the value in the corresponding register to appear in the display. (No. 15 on diagram)
6. Scan/Slew Switch - This switch selects the speed for the reverse direction scan. In the slew position, the reverse speed is 1800 nm/min on the H-10/H-20 line*. (1800 Å/min on the HR-320)*. In the scan position, the reverse speed is the same as the user programmed forward speed. *with 1200 g/mm gratings - (No. 16 on diagram).

III. Function Descriptions - Rear Panel (See illustration, page 10)

1. Circuit Breaker: If the unit does not operate when power has been turned on, press the circuit breaker switch fully in and release. If circuit breaker continually or repeatedly opens, contact factory for assistance. (No. 1 on diagram)
2. On/Off Switch: This switch turns power on for both the control module and the motor. Turning the power switch off will reset all registers to zero. (No. 2 on diagram)
3. 9-Pin Connector: This connector is used to connect the motor to the control module. See specifications for pin assignment. (No. 3 on diagram)
4. Potentiometer Adjust: This slotted screw allows the user to adjust the full scale deflection of the optional 1020-SP wavelength output potentiometer. (No. 4 on diagram)
5. Display direction selector. Set so display agrees with mechanical counter.
6. 5-Pin Connector: This connector is used for interfacing a computer or other external source of control. See specifications for pin assignments. (No. 5 on diagram)
7. Banana Jacks: These terminals allow for remote recorder starting. When the controller begins the scan, the jacks are "shorted" together. The jacks are off whenever the controller is performing "backlash correction" (No. 6 on diagram)

IV. Motor Housing Jacks -

The banana jacks on the stepping motor housing provide the output from the optional wavelength output potentiometer (not available on the HR-320). The ten turn potentiometer gives a zero to one volt signal depending upon wavelength position. The magnitude of the voltage signal may be adjusted using the slotted screw on the rear panel of the controller. See the rear panel description for details.

The potentiometer output is $1\text{mV} = 1\text{nm}$ for monochromators with 1200 g/mm gratings.

V. Operation -

Caution: Do not attempt to manually dial the monochromator when the stepping motor is energized. Damage to the monochromator and/or stepping motor may result. The monochromator may be manually dialed as long as the stepping motor is turned off.

A. General Information:

The Microprocessor Scan Controller is designed to allow the user 4 internal modes of scanning plus external (computer) control. These modes are:

- Single Scan Forward
- Single Scan Reverse
- Repetitive Scanning (scan forward, slew back)
- Cyclic Scanning (scan forward and back)

1. Single Scan Forward: Pressing the FWD key will cause the system to scan in the forward direction at the speed entered into the SPD register. If λ is less than λ_2 at the start of the scan, the system will automatically stop at λ_2 . If λ is greater than or equal to λ_2 , there will be no automatic stop, and the operator must press STP when the desired wavelength is reached. If the monochromator is permitted to scan to the end of its range, the controller will lose its wavelength initialization.
2. Single Scan Reverse: Pressing the REV key will cause the system to scan in the reverse direction at either the speed in the SPD register, or the maximum speed, depending upon the position of SCAN/SLEW switch. When $\lambda > \lambda_1$, the system will automatically stop when it reaches λ_1 . If $\lambda < \lambda_1$, there will be no automatic stop, and the operator must press STP with the desired wavelength is reached. If the monochromator is permitted to scan to the end of its range, the controller will lose its wavelength initialization.
3. Repetitive Scanning: During repetitive scanning, the monochromator will scan from λ_1 to λ_2 at the user selected speed, and slew back, for 1 to 99 cycles. It is best to start a repetitive scan at λ_1 , or the first cycle will not be the same as the rest of the cycles in terms of wavelength

coverage. Press STA to start scanning. STP will interrupt the scan. CNT will continue an interrupted scan from the point at which the scan stopped.

4. **Cyclic Scanning:** During cyclic scanning, the monochromator will scan forward and back from λ_1 to λ_2 at the user selected speed, for 1 to 99 cycles. It is best to start a repetitive scan at λ_1 or the first cycle will not be the same as the rest of the cycles in terms of wavelength coverage. Press STA to start scanning. STP will interrupt the scan. CNT will continue an interrupted scan from the point at which the scan stopped.
5. **Backlash Correction:** In all four modes of internal operation, there are functions for backlash correction and speed ramping. The backlash correction function enables the controller to remove mechanical backlash from the monochromator and the motor drive system, ensuring accurate wavelength control. This is done by having the motor take a number of steps beyond the upper and lower wavelength limits, and then back the same number of steps to resume scanning. During the backlash correction, the controller is considered to be in the "Stop" mode, and thus will not accept any commands from the keyboard. Also, during backlash correction, the recorder remote start jacks (see page 5) are turned off.
6. **Ramping:** The ramping function consists of an acceleration/deceleration algorithm which takes place during the first and last few steps of a scan operation. This function allows the motor to attain considerably higher scan speeds, without any loss of steps. It also prevents the motor from overshooting the destination wavelength during a scan.

B. Setting up the System:

1. Plug the 9-pin connector from the stepper motor module into the rear of the control module.
2. Plug the control module into a 110/120 volt 60 Hz wall outlet.
3. Turn the power switch on. The motor will immediately do a backlash correction and the wavelength display on the controller will be set to 0. All registers in the controller are also set to zero, except the speed "SPD" register which is set to its maximum value.
4. Set the λ , λ_1 , λ_2 , SPD and CYL registers to their desired values (See Front Panel descriptions for details).
5. Choose "Scan" or "Slew" speed for the reverse direction.
6. Press the scanning function that is desired:
FWD Single Scan Forward
REV Single Scan Reverse
STA Start Cyclic or Repetitive Scan
CNT Continue an Interrupted Scan

7. "STP" will interrupt the scan at any time except during a backlash correction.

C. Register Values:

The λ register is the only register whose value will change during the course of a scan. This register, which is updated continuously, changes every time a pulse is issued to the stepping motor.

Any time the motor is stopped, the values of the registers may be checked or changed by pressing the appropriate register key. (See Front Panel function descriptions.)

D. Examples:

1. The monochromator is at 346.2nm. We want to scan from 200nm to 500nm at 750nm/min ten times, slewing back in reverse between scans.

<u>Operation</u>	<u>Display</u>	<u>Comments</u>
a. Turn system on	0	
b. Press λ , then CLR	0	Clear λ register
c. Press 3, 4, 6 and 2	346.2	Initialize
d. Press λ_1 , then CLR	0	clear λ_1 register
e. Press 2, 0, 0, and 0	200.0	set λ_1
f. Press λ_2 , then CLR	0	Clear λ_2 register
g. Press 5, 0, 0, and 0	500.0	set λ_2
h. Press SPD and CLR	0	Clear SPD register
i. Press 7, 5, and 0	750	set SPD
j. Press CYL then CLR	0	Clear CYL register
k. Press 1 and 0	10	set CYL
l. Put scan/slew switch to slew position	10	set reverse speed
m. Press REV	Starts at 346.2 Scans to 200.0	Send Monochromator to λ_1
n. Press STA		Repetitive Scan starts Cycles register will count down to zero as cycles proceed.

At the end of the above scan, the system will be at 200.0 nm.

2. We now want to scan from 400nm to 653.8nm at 750 nm/min for 25 cycles, scanning in both directions.

a. Press λ_2 then CLR	0	Clear λ_2 register
b. Press 4, 0, 0, and 0	400.0	Reset λ_2 to 400.0
c. Press FWD	Starts at 200.0 scans to 400.0	System will scan to 400nm and stop automatically
d. Press λ_1 then CLR then 4, 0, 0, and 0	400.0	Clear λ_1 reset to 400.0
e. Press λ_2 , then CLR then 6, 5, 3, and 8	653.8	Clear λ_2 reset to 653.8

<u>Operation</u>	<u>Display</u>	<u>Comments</u>
f. Press CYL then CLR then 2 and 5	25	Clear CYL and reset to 25
g. Put scan/slew switch to scan position	25	Set reverse speed
h. Press STA to start scan		

IV. Potentiometer Installation:

This operation should be performed before the motor housing is mounted on the monochromator.

1. Remove the cover from the motor housing;
2. Attach the metal portion of the drive coupling to the rear of the motor shaft.
3. Remove the two (2) extender posts from the potentiometer assembly and screw them onto the screws extending from the motor bracket.
4. Fit the potentiometer assembly so that the shaft couplings mesh, and screw the assembly onto the extenders.
5. Plug the connector on the potentiometer assembly into the connector on the inside of the motor housing covers.
6. Install stepping motor onto the monochromator. (See the monochromator manual for instructions).

VII. Computer Interface:

The Microprocessor Scan System will accept external TTL signals for driving the system. The 5-pin connector on the rear of the controller is used for external input. Pin H is ground, Pin D is pulse input for the reverse direction, and Pin E is the pulse input for the forward direction. Each external pulse will cause the motor to take one step in the specified direction. See specifications for the required values.

The LED digital wavelength display will be active during external control and will show the correct wavelength as it "sees" the external inputs and is updated by them.

VIII. Specifications:

Power Input	120V 50-60 Hz 50W (can be changed to 220V input with internal jumper)
Output for Motor	9-pin connector 166 Hz to 4-chase stepping motor 12V 25W 1V for potentiometer 12V for external power (used for double motor drive)
Computer Input	5-pin connector H=ground D=pulse input positive transition, advances motor in reverse direction, pulse length min. 100 micro sec., 0-5V TTL, 300 Hz Max.

Computer Input
(cont.)

E=Pulse input positive transition,
advances motor in forward direction,
pulse length min.
100 micro sec., 0-5V TTL,
300 Hz Max.

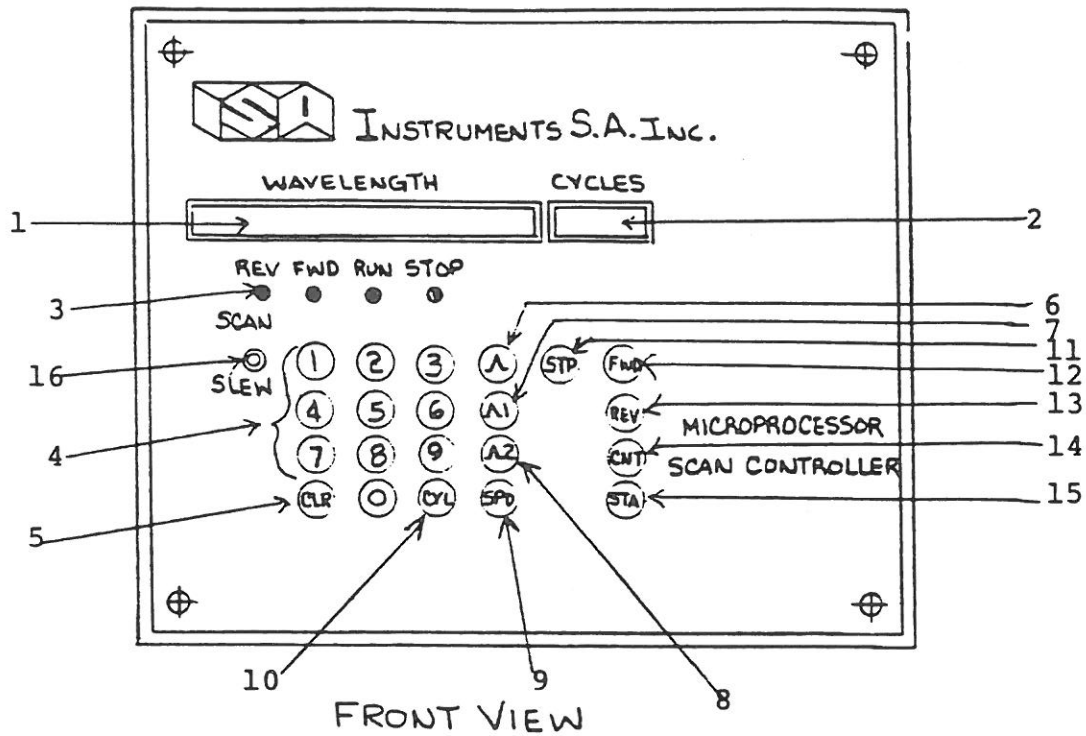
A=pulse output, forward direction

B=pulse output, reverse direction

(A and B can be used for external
display of wavelength)

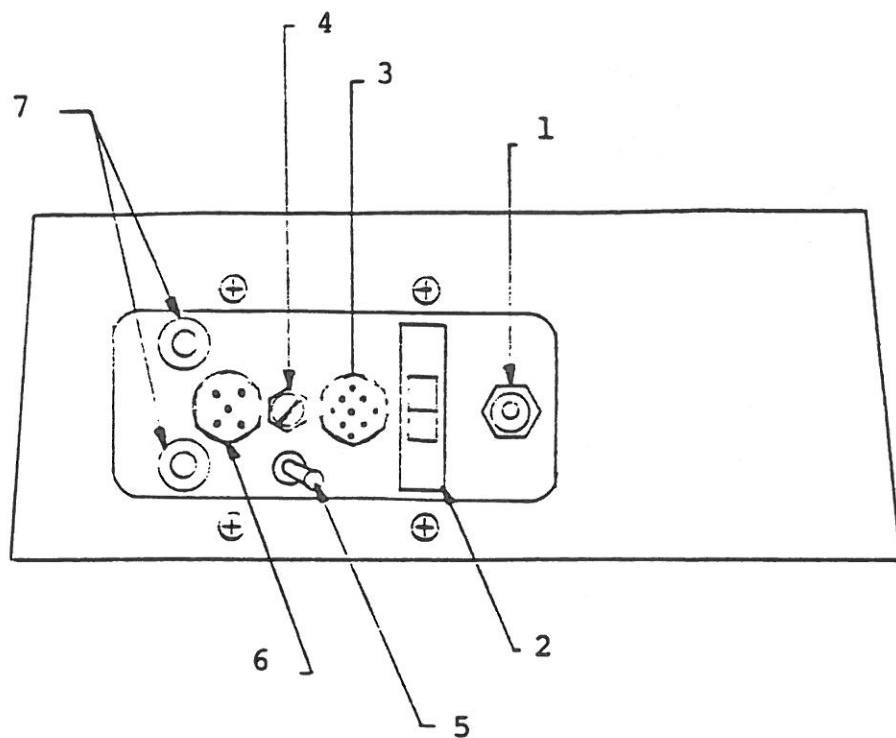
2 Banana Jacks

For remote control of recorder, when
stepping motor is in motion, the 2
banana jacks are shorted together.

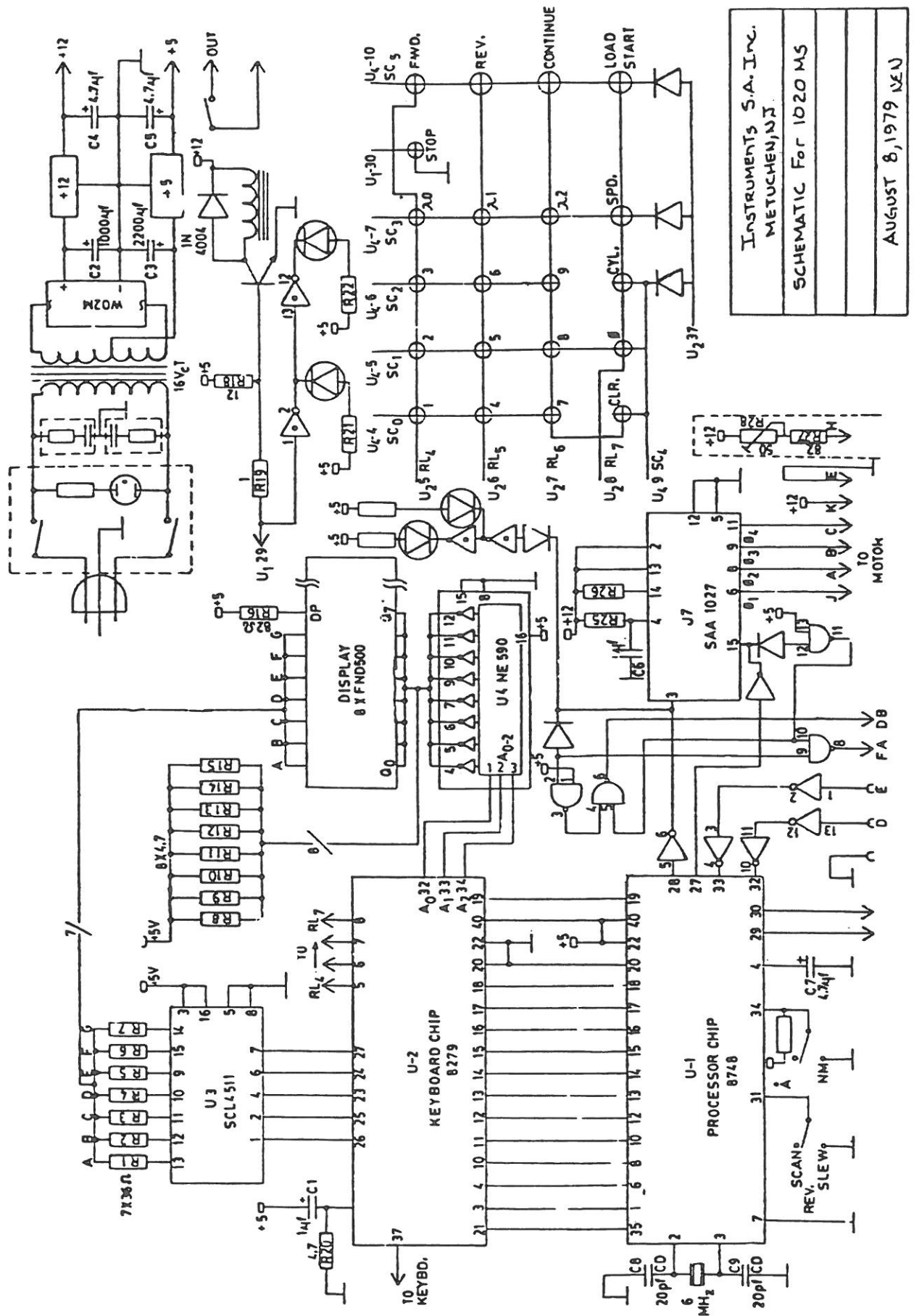


KEY

- | | |
|---------------------------|----------------------|
| 1. LED Wavelength Display | 9. SPD Key |
| 2. LED Cycles Display | 10. CYL Key |
| 3. LED Function Lights | 11. STP Key |
| 4. Black Numerical Keys | 12. FWD Key |
| 5. CLR Key | 13. REV Key |
| 6. λ Key | 14. CNT Key |
| 7. λ_1 Key | 15. STA Key |
| 8. λ_2 Key | 16. Scan/Slew Switch |



- 1) Circuit Breaker
- 2) On/Off Switch
- 3) 9-Pin Connector
- 4) Potentiometer Adjust
- 5) Display Direction Selector
- 6) 5-Pin Connector
- 7) Banana Jacks



WARRANTY

Instruments SA, Inc. warrants each instrument of its own manufacture to be free from defects in material and workmanship for a period of one year. Obligations under this warranty shall be limited to repair or replacement at our option, of any instrument returned, shipment prepaid, to our factory for that purpose within one (1) year of delivery to the original purchaser, provided prior authorization for such return has been given by an authorized representative of Instruments SA, Inc.

The warranty does not apply if damage to the instrument has been caused by neglect, operation in an adverse environment, or normal wear and tear.